

## **DRAFT: Charter for the Science and Technology Definition Teams (STDTs) for Reduced-Scale Exoplanet Direct Imaging Mission Concepts**

### **Purpose**

The Astrophysics Division, through its Exoplanet Exploration Program Office, is initiating mission concept studies of probe-class missions to advance the science of an exoplanet characterization and imaging mission as prioritized in the Astronomy and Astrophysics 2010 Decadal Survey<sup>1</sup>. The highest priority Decadal Survey medium scale recommendation is a New Worlds Technology Development Program in preparation for an exoplanet imaging mission beyond 2020, including precursor science activities. The Decadal Survey's proposed program is designed to allow a habitable Exoplanet imaging mission to be well formulated in time for consideration by the 2020 Decadal Survey.

Two Science and Technology Definition Teams (STDTs) for reduced-scale exoplanet direct imaging mission concepts are chartered to define reference mission concepts of high scientific, technical, and programmatic merit that would both advance the compelling scientific priorities articulated in the Decadal Survey and be executable within the Astrophysics Division's current budget profile. As described in the NASA Astrophysics Strategic Implementation Plan<sup>2</sup>, these mission concepts would be candidates for prioritization by the 2020 Decadal Survey as a mission to follow WFIRST; if a large mission like WFIRST cannot be started this decade, then an Exoplanet probe which is technologically ready would be a candidate for a probe to start this decade as early as FY2017. An FY 2017 new start, followed by efficient development for the selected mission, requires mature technology by the end of this decade. The mission concept studies will identify technology requirements, and these will be used to guide technology investments during this decade.

Leading toward the NRC Mid-Decade Review, the results of the concept studies will be considered by the NASA Astrophysics Division and jointly evaluated along with studies from both the Physics of the Cosmos Program and the Cosmic Origins Program. The probe-scale mission concepts developed by the STDTs are intended to be representative of concepts that are fully responsive to the constraints described above. They are not intended to be the only possible probe-scale exoplanet mission concepts for consideration by the Astrophysics Division in its strategic planning.

### **STDT Scope**

The Exoplanet Exploration Program Office will work with the science community to develop new probe-scale mission concepts capable of direct imaging of exoplanets. Two Exoplanet Direct-imaging STDTs (ExoD-C and ExoD-S) will be established:

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<sup>1</sup> *New Worlds, New Horizons in Astronomy and Astrophysics* (NRC, 2010); [http://www.nap.edu/catalog.php?record\\_id=12951](http://www.nap.edu/catalog.php?record_id=12951).

<sup>2</sup> *NASA Astrophysics Strategic Implementation Plan* (December 20, 2012); <http://science.nasa.gov/astrophysics/documents/>

- ExoD-C will explore potential probe-class implementations involving the use of an internal coronagraph
- ExoD-S will explore potential probe-class implementations involving the use of an external occulter (starshade).

The science goal of the ExoD-C and ExoD-S teams will be to establish science requirements, investigation approaches, key mission parameters, and other scientific studies needed to support the definition of an implementable space mission concept. The technical goals of each STDT will be to establish the programmatic, technical, risk, and implementation approach in the current environment where significant attention is paid to cost performance for NASA projects.

Among the products to be delivered by the STDTs, working with the Exoplanet Exploration Program Office, will be a Design Reference Mission (DRM) that includes:

1. Science return (baseline and minimum requirements) from a cost-driven, probe-scale mission that is traceable to the recommendations of the Astronomy and Astrophysics Decadal Survey.
2. Observatory performance requirements that meet the science requirements.
3. An interim Architecture Trade Study within each STDT to select from various options an architecture and instrument(s) to develop in greater detail for the DRM and for documentation in a detailed Mission Concept Report.
4. A detailed Mission Concept Report in support of the science and performance requirements with instrument descriptions, containing enough fidelity to be evaluated through a cost appraisal and technical evaluation (CATE). The Report will include a top-level schedule for formulation, implementation, and operations and will also include an assessment of top technical risks to achieving the baseline science requirements.
5. The reports will assess the current state of technology needs for the selected architecture, and identify needed technologies to be developed through approximately 2019. Any required technologies must be brought to maturity by the forecasted year of a PDR within the anticipated budget profile of the NASA Astrophysics Division. Each STDT will recommend a PDR readiness date based on its technology assessment.
6. Updates to the Mission Concept Report factoring in any feedback from the CATE.

To make the STDTs consistent with one another and with the Astrophysics Strategic Implementation plan, the STDTs will plan for their concepts to be technically viable for a launch by the end of calendar year 2022 if funding starts for implementation in fall of 2016 (beginning of government fiscal year 2017).

The Exoplanet Exploration Program Office will provide at the kickoff meeting the program guidelines for trade criteria to be used for the Architecture Trade Studies.

## **Organization**

The STDTS will be supported by the Exoplanet Exploration Program Study Office located at JPL. Each STDTS is independent of the Study Office yet is expected to work in close coordination. Each STDTS and the Study Office will iterate on science requirements and the mission concepts that flow from these and will share results with each other in a two-way exchange. The STDTS may ask the Study Office for additional data or to study particular mission concept(s), technical and/or programmatic trades, or other studies, including variations of concepts already studied or new concepts.

The STDTS may seek input from scientists and technologists external to the STDTS. The Study Office may ask the STDTS for scientific or technical assessments, perspectives, and/or studies. Any external scientific inputs and discussions needed by the Study Office will flow through the STDTS only. The Study Office may also seek internal scientific or technical perspectives from NASA scientists for help in developing mission concepts based on the findings of the STDTS. Such scientists will be named by the Study Office, and their perspectives will be shared with the STDTS.

For efficiency the Exoplanet Exploration Program will staff one Study Office to support both STDTS and will bring in specialists as needed to support the two concepts. No firewall will be required between the Study Office and each STDTS since the purpose in convening these STDTS is to make each concept as strong as possible for consideration by the Astrophysics Division.

Each STDTS Chair will act as the official point of contact between the members of that STDTS and NASA representatives for any issue of programmatic, technical, or budgetary nature.

## **Membership**

STDTS members will be selected by NASA HQ from the pool of applicants that respond to the call for applications. Members will be selected for balance among expertise in relevant science areas, relevant hardware and technology, optics, and both ground and space-based approaches to the implementation of the science priorities. To avoid complications from Federal export regulations, only US citizens or US permanent residents (green card holders) are allowed to be members of the STDTS. The STDTS Chairs will be appointed from the STDTS membership by the NASA Astrophysics Division Director.

The NASA Exoplanet Exploration Program Scientist (HQ), Exoplanet Exploration Program Office Chief Scientist (JPL), and possibly other agency representatives will be ex-officio members of each STDTS.

## **Meetings**

The initial meeting of the STDTS will occur at JPL during early May 2013. Face-to-face meetings no more than quarterly are anticipated, in addition to regular (roughly biweekly) telecons. Meetings will be called by the STDTS Chairs, and the agendas will be set by the Chairs in coordination with NASA HQ and the Study Office to ensure that planned activities are aligned with programmatic needs and expectations. All meetings of the STDTS will be open to nonmembers who are US citizens or permanent residents.

## **Time Commitment**

Members will be expected to attend the in-person meetings and participate in the telecons. There will be work and writing assignments for members that will take approximately an additional 2 days per meeting.

## **Reports**

Each STDT will deliver a preliminary Mission Concept Report to the Exoplanet Exploration Program to be used by the Study Office for the CATE. A final report will be delivered to the Exoplanet Exploration Program, factoring in any iterations due to the CATE.

## **Termination**

The STDTs will be disbanded after the delivery of the Mission Concept Report to NASA and prior to any future Announcement of Opportunity (AO) for participation in possible mission(s) related to these studies.

## **Public Release of Information**

Any public release or discussion of the STDT or Study Office status, or results of findings, studies and concepts, shall be coordinated directly with NASA HQ beforehand. All reports and other output of the STDT studies will be made publicly available to the extent that is consistent with Federal export regulations (e.g., ITAR).

## **STDT Timeline**

|            |   |
|------------|---|
| 3/31/2013  | Announcement of Membership  |
| 5/7-8/2013 | Joint Kickoff (face-to-face) for both STDTs with Exoplanet Exploration Program Office and Study Office. Introduction of trade criteria. Will include both parallel and combined sessions. |
| 11/15/2013 | (On or before) Briefing of the Architecture Trade Study to Exoplanet Exploration Program  |
| 9/30/2014  | Preliminary report as input to CATE   |
| 3/31/2015  | (No later than) Final Mission Concept Report and CATE   |

## **Logistics**

The Exoplanet Exploration Program Study Office will provide logistical support for the STDT, including arranging meetings, in person and by phone, and providing online resources. Travel to the STDT meetings will be funded by the Exoplanet Exploration Program Study Office, subject to NASA policies and availability of funds from NASA. No support other than travel will be

provided by NASA to the STDT members. The Study Office will provide support and direction in conjunction with NASA HQ for all ITAR sensitive activities and products.

### **Points of Contact**

The NASA HQ point-of-contact is Dr. Douglas Hudgins ([Douglas.M.Hudgins@nasa.gov](mailto:Douglas.M.Hudgins@nasa.gov)). The Exoplanet Exploration Program Office point-of-contact is Dr. Stephen Unwin ([Stephen.C.Unwin@jpl.nasa.gov](mailto:Stephen.C.Unwin@jpl.nasa.gov))

[To be signed when final]

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